him, I am charged with an 'attempt to seize the credit,' and with taking part in a 'proceeding;' and the quotation is 'irrelevent!'

The Mt. Hamilton observations of canals within the dark regions were made in 1892. Mr. Douglass says that he and Prof. Pickering also observed them, at Arequipa, in 1892. What I objected to was the fact that Mr. Lowell's book speaks of them as if they were discovered at Lowell Observatory, in 1894, by Mr. Douglass and were absolutely new. The 1892 observations, by two other observers, are entirely overlooked by Mr. Lowell. For venturing to suggest that their history did not begin in 1894, I am charged with an 'act of appropriation.' Further, so long as Mr. Lowell considers the network of fine dark marking to be, not water, but *vegetation*, and persists in calling them 'canals,' he cannot object when another observer of a more scientific turn of mind chooses to call them 'streaks,' so long as no one knew, and no one even now knows, their real character.

The first projections on the terminator of Mars were observed at Mt. Hamilton in 1890. The first one was, as Mr. Douglass says, detected by a visitor on one of the public Saturday nights. All the facts there are in the case were published by the Lick Observatory staff on two or more occasions, and Mr. Douglass is indebted wholly to those published accounts for his information. The *morale* of this observatory is such that full credit is always given in such a case. If the other observatory in question had been equally disposed to give credit I should not now have to give the history of the subject. Mars was not regularly observed at Mt. Hamilton in 1890. The great telescope was devoted to other important work. On Saturday nights the telescope was directed upon Mars for the benefit of 100 to 300 visitors, and at such times the astronomer in charge very often did not place his eye to the telescope for several hours. It was on one of those occasions that a very prominent projection presented itself. For suggesting that the history of the prominences did not begin in 1894, I am charged with 'an attempt on the rights of property.'

About vegetation, what did Schiaparelli say? He said the variations observed might be the result of 'extensive agricultural labor and irrigation upon a large scale.' The observed appearances might be explained by 'changes of vegetation over a vast area.' And his comment on those theories is as follows: "For us, who know so little of the physical state of Mars, and nothing of its organic life, the great liberty of possible supposition renders arbitrary all explanations of this sort, and constitutes the gravest obstacle to the acquisition of well-founded notions." Nor is this all, for Prof. W. H. Pickering suggested the same theory many years ago.

About Mr. Douglass' paragraph 8, what are the facts and why does he not publish them? Here are the facts: In 1892 at Alleghany Observatory it was determined that the markings on Mars came to the central meridian 7 degrees (about 28 minutes) later than the predicted time and attention was called to the discrepancy. In 1894 Mr. Lowell at Flagstaff observed the same discrepancy, but estimated its value at 5 degrees (about 20 minutes). Here are two observations of the same discrepancy. One observer of long experience estimates it at 7 degrees; and the other observer at 5 degrees. In the book under review the 5-degree estimate is unfurled to the breeze from Flagstaff, whereas the 1892 results are not even displayed at half-mast, though the author was aware of their existence. And yet when my review called attention to the fact that the discrepancy was observed and commented upon in 1892, Mr. Douglass says that it 'will be seen to be an error.'

My remark "that there should be so many evidences of *apparent* lack of familiarity with the literature of the subject" was certainly the most *charitable* form in which I could speak.

W. W. Campbell.

SCIENTIFIC LITERATURE.

The Primary Factors of Organic Evolution. By E. D. Cope, Ph.D. Chicago, The Open Court Publishing Co. 1896.

In *Primary Factors of Organic Evolution*, Prof. Cope is no longer a setter-forth of new doctrines, but "the present book is an attempt to select from the mass of facts accumulated by biologists, those which, in the author's opinion,

throw a clear light on the problem of organic evolution, and especially that of the animal kingdom." (p. v.) That he has well succeeded in this attempt Neo-Lamarckians will be likely to give cordial assent upon reading these pages. But those who believe that natural selection has played a chief and essential rôle in all evolution will not be so well pleased with Prof. Cope's account of the matter.

The book is a direct plea for the efficiency of those factors of evolution which were prominently set forth by Lamarck and further elaborated by later writers; and it will stand as the most concise and complete exposition of the doctrines of the Neo-Lamarckian school hitherto published; pervaded, however, by the extreme Copean doctrine that consciousness is the prime mover in all organic evolution. This latter doctrine, elaborated and brilliantly expounded by Cope in his 'Origin of the Fittest,' and called Archæsthetism, though barely suggested previously by Erasmus Darwin, constitutes the fundamental thesis of Cope's theory of organic evolution. He describes it in the following words:

"It maintains that consciousness as well as life preceded organism and has been the *primum mobile* in the creation of organic structure. This conclusion also follows from a due consideration of the nature of life. I think it possible to show that the true definition of life is: *Energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility.* If this be true, the two statements that life has preceded organism, and that consciousness has preceded organism are coequal expressions." (P. 513. Quoted from 'Origin of the Fittest,' p. 428.)

That Prof. Cope regards this consciousness as distinct from the physical basis of protoplasm which it is conceived to influence is shown by the following quotation:

"The relation of consciousness to the physical basis is as yet a profound mystery, but that they exercise over each other a definite mutual control is unquestionable." * * * "In other words, the forms of thought, which have no weight, direct the movements of muscles, which have weight." (P. 506.)

In like manner another quotation indicates that his conception of consciousness distinguishes it from a form of energy, for he says: "Whether the intrinsic energies which accomplish evolution be forms of radiant or other energy only, acting inversely as the square of the distance, and without consciousness, or whether they be energies whose direction is affected by the presence of consciousness, the energy is a property of the physical basis of tridimensional matter, and is not outside of it, according to the doctrine we are about to consider." (P. 1.)

While the phenomena of life are thus conceived of as fundamentally influenced by this, may I call it unknown quantity, consciousness, Prof. Cope recognizes the fact that the actual phenomena themselves are the direct expression of some form of energy.

"The phenomena of growth are also evidently exhibitions of energy. The term energy is used to express the motion of matter, and the building of an embryo to maturity is evidently accomplished by the movement of matter in certain definite directions. The energy which accomplishes this feat is, however, none of those which characterize inorganic matter." (P. 475).

This energy peculiar to living organism is called Bathmism.

"All the mechanisms necessary to the mature life of the individual are constructed by the activity of the special form of energy known as growth-energy or Bathmism. It is the modifications of this energy which constitute evolution." (P. 479.)

Having constructed this conception of an energy which may be present in definite quantities in any particular individual, the energy or mode of motion is treated of as a measurable somewhat, which may be passed from one individual to another, as is illustrated by the following passages:

"All this means that a certain limited quantity of energy is at the disposal of each individual organism." (P. 481.) "The most rational conception of this inheritance of structural characters is the transmission of a mode of motion from the soma to the germ-cells. * * * The bathmic theory of heredity bears about the same relation to a theory of transmission of the pangenes of Darwin, or the ids of Weismann, as the undulatory theory of light and other forms of radiant energy does to the molecular theory of Newton." (P. 480.)

As one speaks of the absorption or dissipation of light or heat, so he speaks of the phenomena of organic growth as involving

"the absorption of energy and not its dissipation." (P. 483.)

In elaborating this theory energies are distinguished into two classes. The first class includes those which tend away from the phenomena of life, 'catagenetic,' some of which are exclusively organic, myism and neurism; while others are both organic and inorganic, as gravitation, cohesion, chemism and radiant energy. The other class, 'anagenetic,' includes only those which tend toward the phenomena of life. The particular form of this "energy, which is displayed by the plant in the elaboration of living from non-living matter is called antichemism" (p. 483), the other growth-energies are called 'bathmisms.' Bathmisms are further subdivided according as they are influenced by the interference of energies which are derived from sources external to the germ plasma.

To the 'simple growth force,' which is directly inherited without interference of other forces is given the name 'emphytism,' to distinguish it from the modified forms of growth force called 'grade growth force,' to which the name bathmism is strictly applied. As the author remarks, "pure emphytism can only be observed in the embryos of sexless or parthenogenetic origin, and in the repair of tissues." (P. 485.)

We thus are left with bathmism as the mode of energy, and bathmogenesis as the process by which the phenomena of evolution are accomplished.

As the present writer understands the author, his idea is that it is through the interaction or interference between energies from without the germ, though not necessarily outside the soma, and the particular bathmic energy of the germ itself which determines the specific morphological characters of each organism.

Under Part II., 'The Causes of Variation,' the author discusses the ways by which these interferences are accomplished. These external influences are found to be of two classes, physicochemical (molecular) and mechanical (molar). The class of evolutional phenomena resulting from interference between the molecular energies and bathmism are given the name 'Physiogenesis,' those resulting from interference between molar energy and bathmism are called 'Kinetogenesis.'

In the chapter on physiogenesis are found illustrations quoted from various authors of cases of physiogenesis, as the conversion of Artemia into Branchinecta; the production of colors in Lepidopterous pupæ; the effect of feeding on color in birds; the blindness of cave-animals, etc.

In illustration of the law of kinetogenesis the studies made by Dall on the origin of the plaits in the columella of the Gastropods, and by Jackson on the mechanical origin of characters in the Lamellibranchs, are cited from the Invertebrata.

Kinetogenesis in the Vertebrata is elaborately illustrated by numerous references to the work of other authors and his own researches, on the effects of 'impact' and 'strains,' in modifying osseous tissue, the form of limb articulations and vertebral center, on the increase of size through use, the size and number of digits and the modification of the shape of horns, etc. But perhaps the most interesting and satisfactory application of the law is seen in the explanation of the mechanical origin of dental types, in which the paleontological evidence has proven of the greatest value and has given powerful confirmation to the general neo-Lamarckian theories, which find their strongest supporters among the vertebrate paleontologists of the United States.

The effects of disuse are also exemplified in the cases of atrophy, abortion and modification of limb-bones in mammalia.

This 'use and disuse' of Lamarck, under the modes of physiogenesis and kinetogenesis, are the processes through which variation of form and structure are attained.

Natural selection is recognized as a means and mode of the accentuation and preservation of modifications found to be useful; but the author is particular to note that natural selection does not induce variability, but simply preserves such variations as arise and are beneficial to the being under its conditions of life, quoting from Darwin in support of this view (p. 4). Thus he takes exception to the extreme Neo-Darwinian, or Wallacean doctrine, as it is called by Romanes, in so far as to deny that species and the distinctive characters of every species are due to natural selection.

In Part 1st the common phenomena of evolution are expounded by examples of a vivid

nature under the three headings—variation, phylogeny and parallelism.

The chapter on phylogeny brings together a number of pertinent examples from the facts of vertebrate paleontology, while variation and parallelism are illustrated by both the Invertebrata and the Vertebrata.

Under the subject of heredity over thirty pages are devoted to the defense and proof of the reality of transmission of acquired characters, and for this purpose are cited a goodly array of evidences from both embryology and paleontology.

The particular memory theory of heredity, of which the general principles were stated by Sedgwick as early as 1863, and elaborated by Cope in 1889, formulated by Herring in 1870 and named 'Mnemnogenesis' by Hyatt in 1893, is adopted as best expressing the authors view. The following passage presents a characteristic definition of this factor of evolution.

"It appears to me that we can more readily conceive of the transmission of a resultant form of energy of this kind to the germ-plasma than of material particles or gemmules. Such a theory is sustained by the known cases of the influence of maternal impressions on the growing fœtus. Going into greater detail, we may compare the building of the embryo to the unfolding of a record or memory, which is stored in the central nervous organism of the parent, and impressed in greater or less part on the germ-plasma during its construction, in the order in which it was stored. This record may be supposed to be woven into the texture of every organic cell, and to be destroyed by specialization in modified cells in proportion as they are incapable of reproducing anything but themselves. The basis of memory is reasonably supposed to be a molecular (or atomic) arrangement from which can issue only a definite corresponding mode of motion." (P. 451.) "The somatic cells retain only the record or memory of their special function. On the other hand, the reproductive cells, which most nearly resemble the independent unicellular organisms, retain first the impressions received during their primitive unicellular ancestral condition; and second, those which they have acquired through the organism of which they have been and are only a part." (P. 453.)

To the question what are the primary factors of organic evolution from a causative point of view, the author's answer in brief seems to be as follows: *Bathmism* an intrinsic energy of living matter; *consciousness*, a guiding influence, 'intrinsic in the evolving matter,' but preceding organization; *molecular and molar forces* from without reacting upon bathmism in the processes of Physiogenesis and Kinetogenesis; and the effects of these interactions preserved and perpetuated in heredity through the agency of *memory* in the process called Mnemnogenesis. Viewed as a series of phemonena the author has summarized the particular form of doctrine defended in his book in the following words:

1. Variations appear in definite directions.
2. Variations are caused by the interaction of the organic being and its environment.
3. Acquired variations may be inherited.
4. Variations survive directly as they are adapted to changing environments (natural selection).
5. Movements of the organism are caused or directed by sensation and other conscious states.
6. Habitual movements are derived from conscious experience.
7. The rational mind is developed by experience, through memory and classification (p. 14).

Most, if not all of the particular views of the author found in this book have been more or less fully elaborated in previous papers; but in their connected systematic form, combined with the views of other workers to constitute a consistent doctrine of evolution, we have in 'Primary factors' a valuable text-book for teachers and students.

Whether they will be helped toward an intellectual comprehension of the true factors of evolution by this attempt to express them in terms of those highest of all, most complex and least understood of organic phenomena, consciousness and memory, may be seriously questioned.

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The Manufacture of Explosives. By OSCAR GUTTMANN. 2 Vols., pp. 348 and 444 lg. 8vo. New York, Macmillan & Co. 1895.

As the sub-title of this book indicates, the author has sought to produce a theoretical and practical treatise on the history and the physical and chemical properties, as well as on the methods of manufacture of explosive substances, and he has followed for this purpose the plan adopted in the excellent treatises on Gunpowder